

CMFRI

Research Highlights

1994-'95



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

P.B. No. 1603, COCHIN - 682 014

About CMFRI

The Central Marine Fisheries Research Institute is one of the eight Research Organisations in the network of Central Fisheries Research Institutes under the Indian Council of Agricultural Research devoted to Research, Education, Training and Transfer of Technologies in support of development of Fisheries in India. CMFRI's mandate is to conduct researches on exploited, under- and unexploited marine fisheries resources and fisheries oceanography, to advise on rational exploitation and make forecast of abundance, development and upgradation of technologies for maximising production through mariculture and conducting teaching, training and extension programmes for development of human resources in fisheries.

The Institute with its Headquarters at Cochin and Research and Field centres all along the Indian coast line, conducts mission-oriented researches in important areas of marine capture and culture fisheries on all-India basis as well as regional basis in addition to making district-wise, species-wise and gear-wise production estimates. Besides, the CMFRI also conducts researches on short-term but frontier areas of marine fisheries through *ad hoc* projects funded by different agencies.

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Published by

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Front Cover : The Surgeon fish **Acanthurus leucosternon**, one of the most dominant ornamental fishes of Lakshadweep

Back Cover : A part of the 40 - million capacity penaeid prawn hatchery of **Sterling Shrimpex** at Chirala in Andhra Pradesh, designed and constructed under the **consultancy** programme of **CMFRI**

Director's Introduction

As in the previous years, the CMFRI takes pride in presenting its Research Highlights during this year also. Significant contributions were made in all the programmes undertaken by the Institute. A total of 54 research projects relating to marine capture and culture fisheries were taken up and successfully implemented. Besides, 5 externally funded projects were also carried out. The education and training programmes were carried out as per schedule. The total allocated budget of Rs. 836 lakhs (both Plan and Non-Plan) was utilised fully together with the allocation made towards the end of the financial year. An essential prerequisite for carrying out research in marine fisheries is extensive field work. In spite of the constraints of inadequate funds under T.A. continuing this year also, the programmes were carried out satisfactorily, but with considerable strain. This problem was partly got over by the efforts of the Institute; a project was submitted to the NRSA for the sanction of Rs. 12 lakhs per year to collect sea truth data and fisheries statistics. This programme was only partly approved and the Institute received Rs. 4 lakhs for the period December '94 - March '95.

The Institute continued its efforts to strengthen the research

activities through linkages with other national organisations, where relevant. The remote sensing programme at the Institute participated in the collection of sea truth data for the validation of fishery forecast based on potential fishing zone maps.

The transfer of technology programmes continued, with the staff of the Institute actively participating in the various programmes. The Institute adopted the village Chellanam near Cochin for the transfer of the technology of prawn farming following the group concept, and manufacture and marketing of prawn feed by women in the programme for the empowerment of women.

In the area of consultancy services, the Institute provided service for the: (i) establishment of a 40-million capacity *Penaeus monodon* hatchery to a private entrepreneur in Andhra Pradesh; (ii) monitoring the hydrological and water quality parameters of the Cochin Port Trust; and (iii) identification of areas for coastal aquaculture through site-specific socio-economic surveys for the Space Application Centre (ISRO), Ahmedabad.

The marine fish production data available at the Institute were utilised by several governmental agencies, entrepreneurs and individuals of the fishing industry.

The newly constructed laboratory building of the Institute at Visakhapatnam was occupied and the construction of residential quarters at Cochin, Calicut and Minicoy was taken up during the year.

The infrastructure facilities for research and for the collection of field data were enhanced by updating the existing facilities. A Microearth station linking with the NICNET centres was established at the Institute.

About 100 books and over 1000 journals were added to the library at the headquarters and the Institute's publications like the *Marine Fisheries Information Service T&E Series*, the Bulletins and Special Publications containing the results of research work carried out at the Institute were issued during the year also.

The staff of the Institute participated in different seminars, symposia and workshops and contributed significantly.

The CMFRI is striving hard to fulfil its mandate in the context of the changing scenario in the marine capture fisheries sector, in the context of increasing demand for adopting the different mariculture technologies and also in the context of the need to increase production and exports of marine products. The Institute is well geared up to meeting the various R&D challenges of the marine fisheries sector and to addressing the problems of marine fish production in the EEZ.

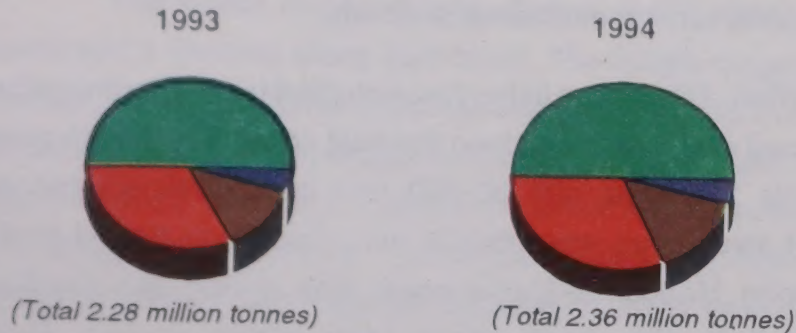
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M. DEVARAJ
Director

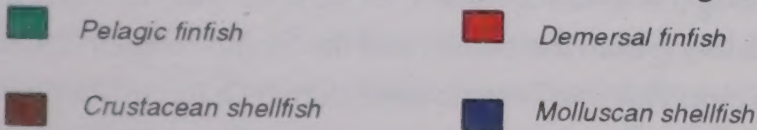
Estimating Fish Production

Estimation of marine fish production is one of the major tasks of CMFRI in view of the importance of this information in carrying out research on exploited stocks, in suggesting regulatory measures, in studying the changing pattern in marine fisheries exploitation and in providing the data to various end-users such as Govt. departments, industry, entrepreneurs and others. The Institute continued its endeavour during this year also; it has been estimated that 2.36 million tonnes of marine finfish and shellfish were landed during 1994 as against 2.28 million tonnes in 1993 showing an increase of 80,000 tonnes. The mechanised units (including motorised crafts) contributed 86.5% of the total landings and the rest by artisanal crafts. The northwest coast contributed the highest landings (36.4% of the total) followed by southwest coast (33.1%), southeast coast (24.5%), northeast coast (4.6%) and Laksadweep and Andaman & Nicobar Islands (1.4%). The salient features of marine fish landings in the country during the year are (1) while the landings along southwest coast remained more or less the same, those along northeast coast showed a decline of 29.3% and those along the southeast coast and northwest coast increased by 12.6% and 15.1% respectively over 1993. The landings of oil sardine, whitebait and mackerel showed decline of 49,000 tonnes, 12,000 tonnes and 45,000 tonnes respec-

tively whereas the landings of croakers increased by 37,000 tonnes, ribbonfish by 21,000 tonnes, carangids by 10,000 tonnes, penaeid prawns by 51,000 tonnes and cephalopods by 17,000 tonnes.



Composition of marine fish landings in India during 1993 and '94



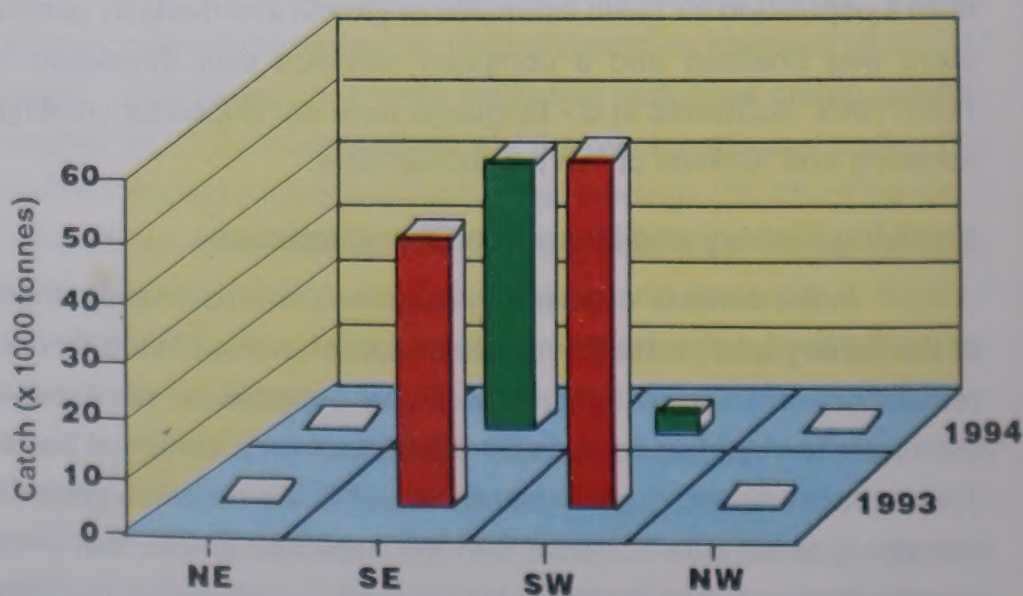
In the stock assessment techniques in marine fisheries research and management, a model for simulating catch samples from a population for given estimates of growth and mortality parameters was finalised and a computer software was developed in FORTRAN. Softwares in C - language were developed for creating, updating and retrieval of fish production data.

Studying Fishery and Resource Characteristics

In the context of ensuring sustained returns, management of the fishery and protection/conservation of overexploited stocks, researches in capture fisheries assume importance; necessarily therefore, the studies have to be carried out on a continual basis. This aspect was adequately taken care of in the research projects pertaining to capture fisheries and the exploited stocks that were investigated include oil sardine, lesser sardines, mackerel, Bombay duck, whitebait, ribbonfish, seerfish and tunas among the pelagic

finfish; threadfin breams, croakers, catfish, lizard fish, silverbellies, goatfish and flatfish among demersal finfish; prawns, crabs and lobsters among crustacean shellfish and squid, cuttlefish, bivalves and gastropods among molluscan shellfish.

Pelagic finfish: Oil sardine fishery was studied from 4 centres along the west coast and 3 centres along the east coast. The length range of *Sardinella longiceps* was 30-200 mm and at Visakhapatnam recruitment size range was 30-100 mm. Spawning period in this species along Mangalore-Malpe coast was during January-May. Recruitment in the east coast took place during June-August. Among the lesser sardines, *S. gibbosa* was the most dominant species along both the coasts and the length range in the catch was 90-185 mm. This species spawned during October-March along Mangalore-Malpe region and during April-June along Tuticorin coast. The most significant feature in the landing of sardines was that while



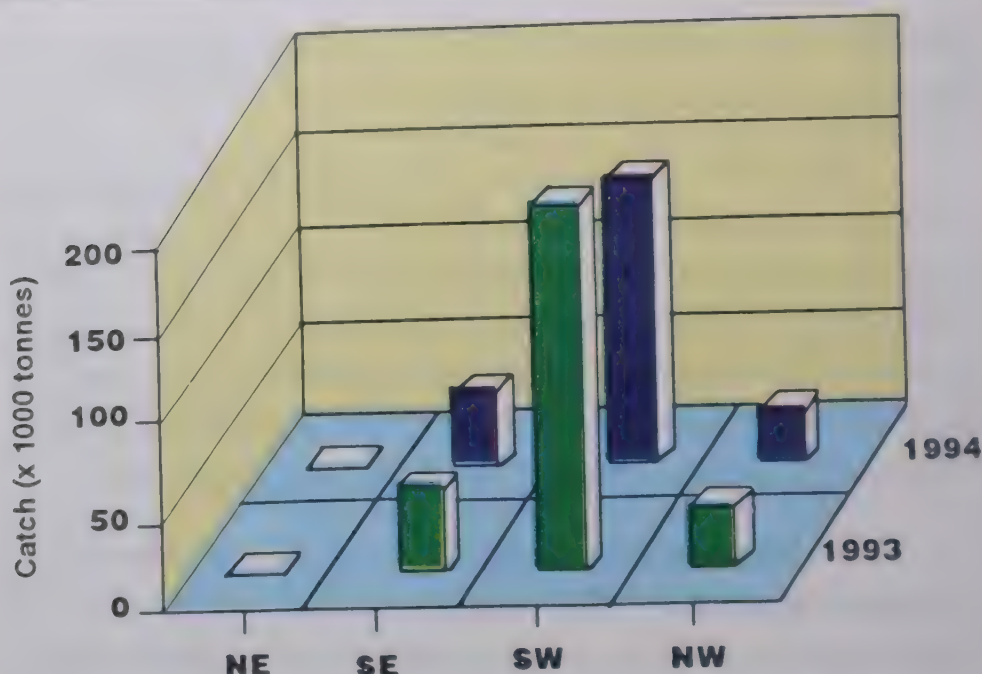
Region-wise Oil Sardine landings during 1993 and '94

there was a further decline of over 30% along west coast, about 240% increase was seen along east coast Centres.

The Indian mackerel was studied at 5 Centres along west coast and 3 Centres along east coast. The length range of exploited mackerel was 55-270 mm. The spawning period was October-March off Mangalore, January-March off Cochin, January-April and August-September off Vizhinjam, October-March off Mandapam and August-March off Visakhapatnam. Recruitment took place during April-July along east coast and February-September along west coast.

The length range of the exploited whitebaits was 30-100 mm in *Stolephorus devisi*, 40-109 mm in *S. bataviensis* and 30-119 mm in *S. buccaneeri*. At Bombay *Coilia dussumieri* of the length range 20-199 mm was caught. *S. macrops* formed major fishery at Cochin during monsoon by the ring seine; during November-December at Mangalore, June-July at Vizhinjam and during July-October at Cochin.

The peak season for seerfish fishery was January at Veraval, August at Cochin and July at Tuticorin and Madras. *Scomberomorus commerson* and *S. guttatus* contributed to the fishery. Fishes smaller than 68 cm of *S. commerson* were caught in trawl and purse seine and the length range in catch by drift net and hooks and line was 36-112 cm. Fishes less than 34 cm of this species were caught in considerable quantities at Mangalore, Cochin and Tuticorin by *podivala*/ring seine/trawl. In the case of tunas, nearly 50% of the catch was obtained by drift gillnets. A marginal increase of about 20% in the tuna catch was observed during the year. However, the catch at Veraval, Cochin, Bombay and Tuticorin registered marginal decline. September-October was the peak season along northwest coast, May-December along southwest coast and June-August in the southeast coast. *Euthynnus affinis*, *Auxis thazard*, *A. rochei* and *Katsuwonus pelamis*



Region-wise Mackerel landings during 1993 and '94

were the principal species and their length range in the catch was 20-76 cm, 26-50 cm, 18-36 cm and 26-72 cm respectively. The researches carried out on tunas indicate that drift gillnet effort for *E. affinis* can be increased along Mangalore-Malpe region; in the case of *E. affinis* and *A. thazard* off Tuticorin there was heavy fishing pressure.

The tuna livebait in the Lakshadweep region was exploited to the tune of 100 tonnes. The mean standard length of these fishes ranged from 14.6 to 78.6 mm. *Spratelloides delicatulus* had protracted spawning period with peak during November-December.

The landings of Bombay duck showed substantial increase along Maharashtra and Gujarat coasts. The length range of exploited population was 30-500 mm along Maharashtra and 15-395 mm along Gujarat. young fish less than 74 mm formed sizable quantity in the

fishery at Bombay. Two spawning periods, one during premonsoon period and another during winter were noticed along Gujarat. In the case of ribbonfish, *Trichiurus lepturus* was the most dominant species all along the Indian coast. The peak fishery period for this species was found to be postmonsoon season. The length range of this species was 20-115 cm in trawl and 30-102 cm in gillnet. The recruitment took place during April-November at different Centres.

Demersal finfish: Elasmobranch resources were investigated from two centres along west coast and three centres along east coast. At Bombay, sharks formed 72% of the elasmobranch catch and *Scoliodon laticaudus* was the most dominant species. The length range of this species was 16-58 cm with an average of 39.5 cm for males and 40-62 cm with an average of 41 cm for females. At Tuticorin, trawlers contributed over 80% to the elasmobranch catch. In the deep sea trawlers, sharks formed 100% of the elasmobranch catch while in shrimp trawlers 79% of the elasmobranch catch was of rays. At Cochin, *Rhizoprionodon acutus* was the most dominant species in drift gillnet and hooks and line, while *Dasyatis* sp. was dominant in the trawl. At Madras the elasmobranch catch showed a marginal decline of 9% in spite of an increase in effort to the tune of 21% over previous year. Trawl contributed to about 97% of the total elasmobranch catch.

The fishery for major perches showed a slight decline over the previous year; these species were exploited by trawlers, hooks and line and gillnets. Along Kerala coast the peak fishery period was December-March while it was May-October in the Gulf of Mannar. At Madras the peak landings were obtained during July-October. At Cochin, the length range of *Epinephelus diacanthus*, *Pristipomoides typus* and *Epinephelus chlorostigma* was around 12-30 cm. At Vizhinjam *Lethrinus nebulosus* was of 20-56 cm length range, while the same was 10-74 cm at Tuticorin. At Madras *Epinephelus tauvina*



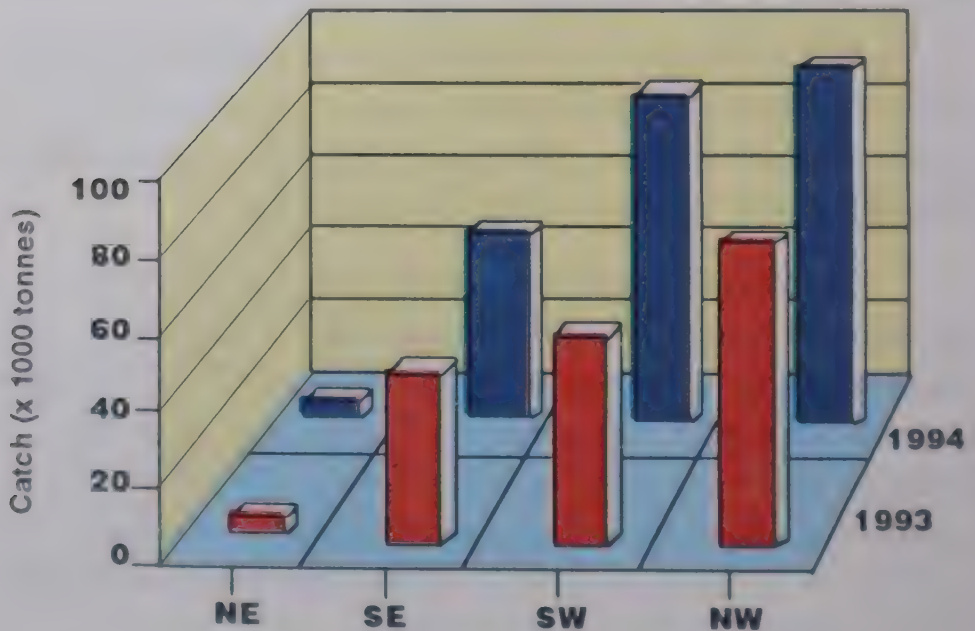
In the case of croakers, the landings registered decline at Veraval, Kakinada, Visakhapatnam and Calicut and increase at Bombay and Madras. Most of the catch was taken by trawl nets. At Madras *Otolithes ruber* was the most dominant species with the length range of 10-25 cm. Mature fish occurred in October-February. *Johnius sina* and *Otolithes ruber* were the dominant species at Calicut. The length range of the former species was 10-16 cm and that of the latter was 14-19 cm. The lizard fish landings showed increase at Bombay, Cochin, Calicut, Beypore, Madras and Visakhapatnam and decrease at Veraval. *Saurida tumbil* dominated at Bombay and Veraval and *S. undosquamis* at Cochin, Madras and Visakhapatnam.

About 95% of the total flatfish landings were along the west coast mainly from Mangalore-Cochin region. Trawlers contributed to the bulk of flatfish landings at Mangalore and Malpe; peak period for the fishery in this region was post monsoon period.

Goat fish showed increased landings along the east coast and decreased landings along the west coast. At Madras the catch rate of this group was 56 kg. *Upeneus vittatus* and *U. bensasi* were dominant along west coast, whereas *U. vittatus*, *U. sulphureus*, *U. sundaicus* were dominant along west coast. Mature and spent fishes occurred in fair numbers during December-January. Peak landings of white fish occurred in November-December; mature fish contributed to the fishery during September-November.

In the Karnataka region, benthic organisms like stomatopods, inedible crabs, gastropods, bivalves, echinoderms were observed to be invariably discarded. Besides, the discarded catch included juveniles of shrimps, cephalopods, finfishes like croakers, flatfishes, perches, flat heads and threadfin breams.

In the studies on the ornamental fishes of Lakshadweep, the data collected so far from 8 inhabited islands showed that wrasses are most abundant numerically and constituted 37.1% of the total population of 13 families of most dominant ornamental fishes in the eight islands, followed by damsel fish (31.9%), parrot fish (8.4%), goat fish (8.2%), squirrel fish (4.7%), surgeon fish (4.6%), butterfly fish (2.1%), groupers (1.2%), trigger fish (0.8%), blasseps (0.6%) and others. A total of 125 species of these 13 groups were collected in addition to others. Among the islands surveyed, Kalpeni has been observed to be richest with 28.8 % of the population of the 13 families.



Region-wise Penaeid Prawn landings during 1993 and '94

Crustacean shellfish: The production of prawns was the highest during the year, penaeid prawns formed 73% of the prawn catch and nonpenaeids 27%. In Maharashtra, *do*/nets contributed to 71% of the nonpenaeid landings whereas in Gujarat, 82% of these prawns were

taken by trawlers. Penaeid prawn landings showed increase at most of the centres. In Kerala over 8,000 tonnes of *Parapenaeopsis styliifera* were landed in the monsoon period, at Cochin. The non-conventional prawn resources like *Trachypenaeus* spp., *Metapenaeopsis* spp., *Solenocera* spp., *Penaeus canaliculatus* were landed in considerable quantities due to extension of trawling into the relatively deeper waters along the west coast of India. Along the east coast, the trawlers fishing in the 100-200 m depth, landed deep sea prawns like *Metapenaeopsis* sp., *Heterocarpus* sp., and *Solenocera* sp. in considerable quantities. The lobster landings registered an increase with Gujarat ranking at the top in regard to their landings followed by Tamilnadu, Kerala and Maharashtra. *Thenus orientalis* was dominant at veraval and Madras, *Panulirus polyphagus* at Bombay and *P. homarus* at Calicut. However, *T. orientalis* which used to be a dominant species contributing to about 45% of the lobster landings till 1985, was totally absent in the trawl catches at Bombay. Tamilnadu, Gujarat and Kerala contributed to the major crab fishery of the country. *Charybdis cruciata* has emerged as a dominant component in the crab fishery at Bombay, Mangalore, Cochin and Sakthikulangara due to fishing in deeper waters.

Molluscan shellfish: The cephalopod landings crossed 1 lakh tonnes registering an increase of about 13,000 tonnes over the previous year. The fishery was supported by *Sepia pharaonis*, *S. aculeata* and *Loligo duvaucelii*.

The green mussel along Malabar coast contributed about 3,700 tonnes showing a decline of nearly 1,000 tonnes when compared to the previous year. The clam production in the Kakinada Bay was about 1200 tonnes. In the Kandaleru estuary, about 1,048 tonnes of edible oyster stocks was estimated. The returns of fishing for the black clam *Villorita cyprinoides* in Netoor, Cheppanam and Kumbalangi

were poor due to overexploitation from the natural beds and indiscriminate fishing of under-sized clams.

At Mandapam, 3 chanks tagged earlier were recaptured after 1127-1209 days of their release. At Tuticorin about 3,40,000 nos. of chanks were landed.

Monitoring the Fishery Environment

The various hydrographic characteristics were monitored at Visakhapatnam, Kakinada, Madras, Mandapam, Tuticorin, Vizhinjam, Cochin, Calicut, Mangalore, Karwar, Bombay and Minicoy. Off Visakhapatnam moderate upwelling was observed from April to August. The surface temperature along the southwest coast ranged from 24.3 °C to 25.2 °C off Vizhinjam and from 25.7 °C to 30.4 °C off Cochin. Along the east coast, the SST ranged from 23.3°C to 25.95°C off Visakhapatnam, from 24.36 °C to 30.75°C off Kakinada, 25.4°C to 29.0 °C off Tuticorin, 25.0 °C to 29.5 °C off Madras.

A bloom of *Chaetoceras* sp. appeared off Cochin in April. Zooplankton abundance was high in August in this region.

The study on environmental ecology on coastal zone indicated that the estuaries around Chandragiri and Nileswar were low productive zones.

On receiving reports of an outbreak in the population of tiny, ant-like, fish killer *Cirolana fluviatilis* in July '94 in the Kumbalangi-Perumpadappu area of Cochin backwaters, a study was conducted on this. This organism, an isopod, known as *Arippan* in Malayalam language was found to be a voracious feeder on live or dead organisms especially weak or dead prawns, fishes, fish baits, and fish and crustaceans trapped in nets in the backwater. In different locali-



In the programme of conservation and management of coral reefs, a survey of fringing reefs in the Palk Bay was carried out. It was found that cage fishing for crabs is causing significant damage to ramose corals as the fishermen break many colonies of ramose corals while putting their traps. In the Gulf of Mannar near Krusadi Island, intensive damage to corals and all associated organisms was observed. A detailed report on this and the overexploitation of algae and reef associated animals in the region was submitted to the Govt. of India and Tamil Nadu. In the studies on ancillary marine living resources, the exploitation and export of gorgonids from the south-west coast of India was found to be declining due to the imposition of ban on their export by the forest department.

Remote Sensing and Potential Fishing Zones (PFZs)

In the remote sensing programme, data/charts on PFZs received from NRSA were passed on to fishermen associations, federations, Matsyafed and others for their utilisation and feed back. Awareness programmes were conducted at Quilon, Quilandy, Cannanore, Munambam and Cochin under the MARSIS application project. Field training was given to shore station managers and trainees at fishermen training centres for dissemination of PFZs through radio and telephone at Quilon and Quilandy.

Surveying the Resources in the EEZ

The Institute participated in the cruises of the FORV *Sagar Sampada* and the zooplankton samples collected from the EEZ were analysed. Among amphipods 16 genera have been identified and their length data collected. 4 species of *Lucifer* were identified from samples of 10 cruises. More than 85% of the population of the cladoceran *Penilia avirostris* was found to be within the 50 m area. During the monsoon period high concentrations of *Penilia* and *Evadne*

were found in the 30 m depth zone off Cochin and 40 m depth zone off Karwar:

Correlation of oceanographic data with fish abundance was attempted in relation to selected commercially important species.

Mariculture Technologies

In the context of declining yields from the marine capture sector and the increasing requirements of sea food and in the context of the need for increasing the exports of marine products, development of technologies for mariculture play a major role. The Institute has been carrying out researches in this direction and during the year also considerable progress was made in this area.

Inducing maturation of penaeid prawns: After succeeding in induced maturation, spawning and hatching of *Penaeus semisulcatus* at Mandapam, *P. indicus* was taken for such a study and success achieved. Regulating pH, salinity and light intensity, feeding the brood stock with marine polychaetes and without ablating the eye stalk, spawning of *P. indicus* could be achieved. Different individuals of *P. indicus* matured and spawned 21-28 times within 250-300 days releasing each time 1.7-1.8 lakh nauplii.

In artificial insemination also, *P. monodon* measuring 258 mm and 150 g matured and spawned after 5 days of insemination releasing 2.9 lakh nauplii. The same prawn again spawned after 4 days releasing 4.3 lakh nauplii.

Culturing bivalves: Consequent on the success achieved in induced spawning of *Pinctada fucata*, 2,11,300 spat were produced of which 76,300 were transferred to Valinokkam Bay in Tamil Nadu. In the subsequent spawnings about 1.3 lakh spat were produced of which

13,000 were sold to the Gujarat State Fisheries Department at Rs. 1,300/-. In the breeding and spat production of *Crassostrea madrasensis*, nearly 8 lakh spat were produced. In the case of *Paphia malabarica*, successful spawning took place on six occasions during April, October, November and December with 2 spawnings each in April and November; spawning in April is reported for the first time as the spawning period of this species is known to be October-December. The adult clams for this study were transported from Ashtamudi in Kerala to Tuticorin. A total of about 45,000 spat produced were transferred to the nursery in the Tuticorin Bay. In *Meretrix meretrix* spawning occurred on two occasions, but there was total mortality of the spat. In the induced breeding of green mussel in the Laboratory at Calicut, the larvae were reared upto eyed stage. The edible oyster and pearl oyster spats were transported from Tuticorin hatchery and transplanted into estuaries near Mulki, Dharmadam, Korapuzha, Karwar, Mangalore, Calicut and Cochin. They recorded good survival and growth rate.

The nucleus-implanted pearl oyster, transplanted at Calicut and Cochin (Andhakaranazhi) recorded moderate survival and growth. At Andhakaranazhi 33% pearl production was achieved.

Breeding and sea-ranching: A total of 54,500 seed of *Paphia malabarica* were ranched in the Ashtamudi at Dalavapuram and the retrieval was 8%.

Hatchery reared and farm raised *P. semisulcatus* (3,882 nos.) and *P. indicus* (3,430 nos.) were tagged and released in the Palk Bay. Whereas *P. semisulcatus* was recovered from the trawl catch for 80 days, *P. indicus* was recovered during the first 27 days only. The study also showed that *P. semisulcatus* took 75 days to travel the distance that was travelled in 22 days by *P. indicus*.

In the experiments on sea cucumber (*Holothuria atra*), spawning was achieved on several occasions. In October a total of 2.6 lakh eggs were produced and the number of auricularia larvae produced varied from 12,000 to 1.62 lakhs. Though *H. scabra* was subjected to thermal stimulation in October, there was no response.

Improving Mariculture Technologies

The CMFRI is actively engaged in improving and upgrading the mariculture technologies by conducting researches in Physiology, Reproductive Physiology, Endocrinology, Nutrition, Cryopreservation of gametes, Genetics and Biotechnology.

In the programme on farm performance of compounded feeds in prawn culture in Andhra Pradesh no appreciable difference in AFCRs was noticed between indigenous feed and imported feed. The laboratory studies at Cochin revealed that inclusion of 30% mantis shrimp meal and 40% soya flour in shrimp feeds would be most appropriate. The analysis of leather waste from tanneries in Tamil Nadu revealed a very low protein content (11.31%) and high ash content (41.7%). The study showed that chemicals used in leather processing appear to be detrimental to the prawn and therefore a thorough biological evaluation is necessary before leather waste is used in prawn feed.

Temperature and salinity tolerance studies conducted on two bivalves showed that in *Meretrix casta*, weight gain is a better indicator of tolerance compared to survival; the limits of salinity tolerance were 15 ppt-35 ppt. Maximum weight gain was noticed under 30 ppt salinity. 100% survival was seen at temperatures ranging from $25 \pm 1^{\circ}\text{C}$ to $30 \pm 1^{\circ}\text{C}$. Weight loss was seen when these animals were

exposed to 45 ppt salinity. In *P. malabarica*, the temperature of $27 \pm 1^\circ\text{C}$ and 5 ppt salinity were found to be ideal for survival and growth.

Cryopreservation trials at 0°C , -35°C and -190°C showed that spermatozoa of *P. indicus* could be successfully cryopreserved for a period of two months. 55-80% of freeze-thaw spermatozoa reacted when preserved in cryoprotectants like glycerine mixed with DMSO, DMSO with trehalose, DMSO and glycerine.

In an extensive shrimp farm in Nellore, the disease caused by infestation of *Zoothamnium* in *P. monodon* was effectively controlled by water exchange, feeding regulation and application of tea seed cake and zeolite. A production of 1,200 kg/ha was obtained in this farm at a stocking density of 40,000/ha. The above disease was caused by poor water quality.

In a lobster holding at Madras the sudden mortality was found to be due to sudden decrease in salinity, increase in ammonia concentration, decrease in dissolved oxygen and poor handling during transportation.

In the study of genetic stocks of Indian mackerel, the samples collected from Ambalapuzha in Kerala during and after mud bank periods were compared and it was found that the two samples belong to a homogenous genetic profile.

In the area of endocrinology, the studies were carried out on eyestalk, thoracic ganglion and brain of *Penaeus indicus* and *Parapenaeopsis stylifera*. The extract of eyestalk (0.21 ml) when injected into adult female *P. indicus* (125 mm, 15 g) resulted in inhibition of moulting.

Studying Fisheries Economics

Fisheries being an economic activity besides being a supplier of protein seafood to the population, studying of fisheries economics has received considerable attention particularly in the context of declining yields of several resources in the presently fished areas and the consequent decline in economic returns. The Institute has therefore geared up to study the economics of fishing operations. As a part of this, the economic performance of trawlers at Mangalore, Malpe and Karwar Centres was taken up and the average net income over operating cost was worked out at Rs. 5,588 at Mangalore, Rs. 12,764 at Malpe and Rs. 5,247 at Karwar. The higher revenue received per trip in Malpe was mainly due to greater quantities of prawns and cuttlefishes in the landings.

The studies on marine fish marketing channels in selected Centres at Nagapattinam, Tuticorin and Kanyakumari have been completed. The study showed that (1) the fishermen's share in the consumer rupee ranged from 31 to 72 paise for different varieties, (2) the retailers were getting higher margins than wholesalers for almost all varieties of fish and (3) the mackerel and deep-sea prawns gained marketability in the interior markets like Madurai and Trichy.

Transferring Technologies

Recognising the importance of technology transfer for achieving increased production and employment, the Institute continued and strengthened its activities in extension and technology transfer. In the study on extension of seaweed culture in the Mandapam region, it was observed that majority of the fishermen needed training in seaweed cultivation though they had the knowledge of seaweed recipe preparation; all of them needed financial and technical help to take up this technology. A demonstration and group meeting on seaweed cultiva-



Dr. M. Devaraj, Director discussing with the fisherfolks of Chellanam, in Ernakulam district, a village adopted by CMFRI.

tion was conducted to 40 fishermen and women at Seeniappadargha and Pamban near Mandapam.

In the adoption of shrimp farming technology near Tuticorin, it was observed that stocking rate ranged from 1 to 2.5 lakhs/ha in small and large farms. The average gross production was estimated at 765 kg/crop/ha for small farms and 2-3 tonnes/crop/ha for medium and large farms. A group farming approach in prawn farming was demonstrated in south Chellanam in an area of 36 ha for 50 farmers by organising the farmers into a society to coordinate the management of group farming, to impart training to the farmers in scientific prawn farming and to demonstrate the practices in their fields. The approach was found to be effective and the benefits included increase in production, reduction in the cost of cultivation, enhanced problem-solving ability, better relationships within the family circles and fellow farmers, active participation of women and better attention to weaker farmers.

In the women empowerment model, 3 more units of the 'Matsya Mahila Vedi' were created in different parts of the village for implementation. 10 women successfully carried out prawn farming with the loan and grant assistance; the prawn feed production units registered as 'All Women Small Scale Industry' produced and marketed 10 tonnes of 'Mahima' feed using the low cost technology developed at the Institute; and women were given training in the techniques of net making.

In the transfer of edible oyster and pearl culture technologies along Tamilnadu coast, the Muthupet lagoon in Tanjavur district was surveyed and the availability of seed as well as adult edible oyster in the region was ascertained and education programmes were organised as a part of transfer of technology.

Training and Education Activities

As in the past, the CMFRI has taken active role in training and education programmes through its Krishi Vigyan Kendra (KVK), Trainers' Training Centre (TTC) and Post-Graduate Programme in Mariculture (PGPM). Under the PGPM, 2 batches of M.Sc. and one batch of Ph.D. students underwent the course work. The 1993-96 batch of M.Sc. students successfully completed their deficiency course and the first semester of the regular course. The 1994-97 batch of M.Sc. students were admitted in October '94 and are undergoing the deficiency course. Under the Ph.D. programme, 7 candidates were awarded Ph.D. degree by the Cochin University of Science & Technology for their theses; 4 students of the 1994-97 batch completed their first semester course work.

The TTC conducted six training programmes in mariculture and SCUBA diving for periods ranging from 10 to 45 days and a total of 42 officials were given the training.

The KVK of the Institute conducted Lab-to-Land programmes and training programmes to different sectors including 56 families of SC & ST.

Providing Consultancies and R&D Support

The CMFRI provides consultancy services and R&D support in various aspects of marine capture and culture fisheries in order to utilise the Institutes expertise in assisting the entrepreneurs, governmental and private agencies and, in return to generate funds for the Institute. During the year three consultancies were taken up.

In the consultancy on penaeid prawn hatchery, a 40 million seed capacity hatchery was designed, construction work completed and phytoplankton culture and rematuration facilities were tested successfully for the hatchery of a private entrepreneur at Chirala, Andhra Pradesh.

In another programme, the Institute carried out consultancy to Cochin Port Trust in assessing the effect of dredging in the harbour area for the Reclamation Project in Wellington Island. Data on 16 parameters from 3 stations are collected regularly from January '94.

In yet another programme, the Institute initiated consultancy work in January 1995 for the SAC (ISRO) for conducting socio-economic surveys at selected sites in Ernakulam and Thrissur districts of Kerala.

Publishing the Research Results

As during the previous years, the results of research work carried out at the Institute are published in National and International scientific journals and in the proceedings of the symposia/workshops/seminars. Besides, the Institute has brought out the following publications during 1994-95.

1. *Marine Fisheries Information Service, Technical and Extension Series*, Nos. 127-135.
2. *CMFRI Newsletter* Nos. 61-64
3. *CMFRI Research Highlights* 1993-94
4. *CMFRI Annual Report* 1993-94
5. *Perch Fisheries in India - CMFRI Bulletin* 47
6. *Shrimp feed formulation and feed management - CMFRI Special Publication* No. 60.

Thus, the Institute with its mission-oriented researches on marine finfish and shellfish resources, mariculture, and marine environment; training and education programmes, socio-economic studies and collaborative programmes, effectively continued its efforts to addressing the problems of marine fisheries of India and augmentation of marine fish production.

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